

Advanced Technology Means Better Pay and Benefits for Workers

Manufacturing employers vary considerably in the wages and benefits they offer. "Good jobs" with high wages and benefits are linked to a number of factors, including use of advanced technology and management practices, which require greater skills and training. Nonmetro technology-intensive plants added jobs during 1992-95. Promotion of technology-intensive manufacturing appears to be a promising development strategy.

Economic development efforts tend to focus on creating jobs, but not all jobs are created equal. Most communities prefer employers who offer jobs with high pay and a range of benefits, including health insurance coverage, retirement, leave, and training. Benefits are important not only to workers, but to their families as well. For example, many farmers and other rural self-employed people rely on health insurance coverage obtained through their spouse's employer.

This article explores the factors associated with higher pay and benefits using ERS's Rural Manufacturing Survey (RMS, see app. A, "Definitions"). Manufacturing has been an important source of well-paying jobs with good benefits for rural workers who lack a college education.

Nonunion High Technology Users Offer Compensation Comparable to Unionized Plants

Unions have had an important influence in raising wages and benefits for manufacturing workers. On average, unionized nonmetro plants pay 25 percent more than nonunion plants, and are more likely to provide most types of benefits. Nearly all union plants offer health benefits. Economists disagree on how much unions raise wages. Part of the difference is due to the fact that unionized plants are larger than nonunion plants, and larger plants pay more and provide more benefits. The differential actually due to unionization is probably not as large as indicated by a simple comparison of average wages, but it is surely significant.

While unions benefited workers, high labor costs associated with unions are an obstacle to job creation, and private sector unionization has declined in recent years. Many companies have located their plants in rural areas to avoid unions. Only 14 percent of nonmetro plants in the RMS are unionized compared with about half of urban plants (although our small urban sample size makes the urban number unreliable). There has been some debate over the effect of unions on business locations and job creation, but a recent study showed that counties in "right to work" States have considerably more manufacturing activity than similar counties in States where workers can be compelled to join a union (see T. J. Holmes, "The Effect of State Policies on the Location of Manufacturing," *Journal of Political Economy*, Vol. 106, August 1998, pp. 667-705).

As union jobs become scarcer, plants using advanced technology and management practices appear to be emerging as another source of jobs with high wages and benefits. Plants classified as "high adopters" of technology and management practices paid an average of \$10.07 per hour compared with \$8.81 for "middle adopters," and \$8.09 for "low adopters" (see "Measuring Advanced Technology Use.") High adopters were also more likely to provide each of five benefits.

Advanced technology and management practices are used more commonly by larger plants, so (as was the case in measuring the effect of unions on wages) the apparent effect of technology on wages and benefits may be partly due to the plant-size effect. To avoid this pitfall, table 1 compares wages and benefits of high and low adopters for plants of similar size (50-249 employees). Nonunion high adopters pay wages that are 35 percent higher than wages paid by low adopters. They are much more likely to offer benefits, as well. Ninety-five percent of high adopters offer health benefits compared with 79 percent of low adopters. The most striking difference is in training. Eighty percent of high adopters offer training compared with only 18 percent of low adopters, reflecting a greater need for skill in technologically advanced plants.

Nonunion high adopters provide similar pay and benefits to those offered by unionized plants. Wages are 10 percent lower, but nonunion high-adopter plants are more likely to

Table 1

Worker compensation in rural medium-sized manufacturing establishments, by technology use and unionization*Nonunion plants that use advanced technology offer compensation comparable to union plants*

Type of compensation	Nonunion plants		Union plants
	Low adopter	High adopter	
Average hourly wage	7.13	9.59	10.50
Establishments offering benefits:			
Leave	78.6	98.2	93.2
Health	78.6	94.9	98.3
Retirement	46.6	88.0	89.1
Training	18.1	79.6	59.8
Profit sharing	27.8	65.2	36.1

Note: Includes only nonmetro plants employing 50-249 workers.

Source: Calculated by ERS using Rural Manufacturing Survey.

offer profit-sharing or stock-option plans, which may reflect a different philosophy of compensation that is aimed at achieving greater worker reliability and lower turnover by giving employees a stake in the company's success. High adopters are also more likely to offer training than are unionized plants. Other benefits are similar between nonunion high-adopter plants and union plants.

Wages Grew Faster in Plants Using Advanced Technology

Before endorsing advanced technology as a key to creating "good jobs," more careful analysis is required. Advanced technology and management practices increase manufacturing worker skill requirements and productivity. While this should lead to higher wages and benefits, other research found that adoption of new technology was associated with higher earnings (as we found here), but no connection was found between adoption and growth of earnings. That suggests that the earnings difference could be due to the fact that companies paying the highest wages are also the most likely to adopt new technology.

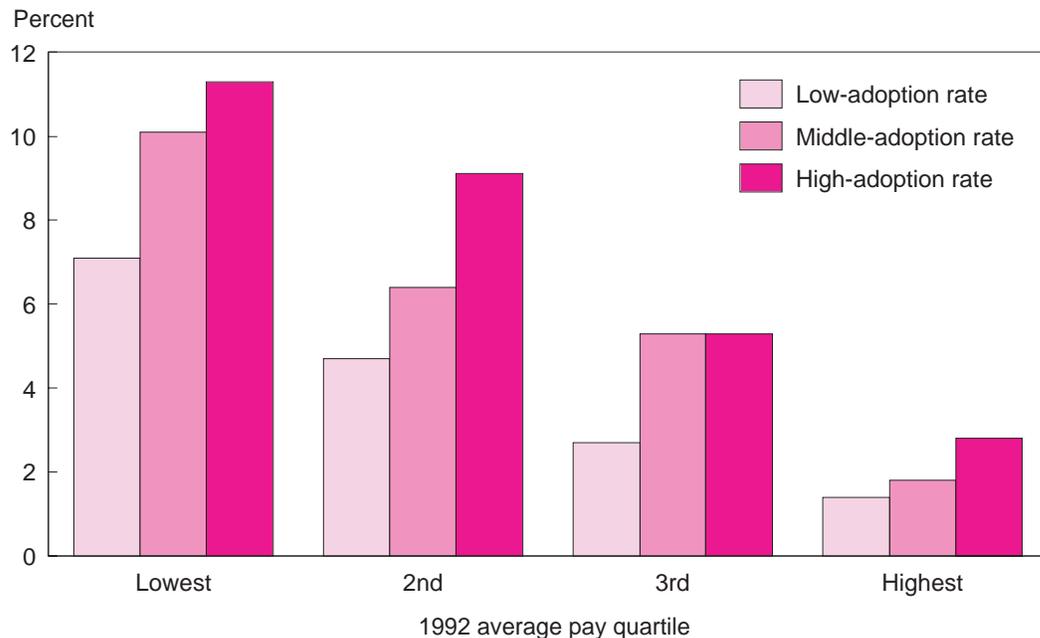
The RMS data do not allow us to directly examine wages "before and after" technology adoption. We can, however, look at whether wages grew faster between 1992 and 1995 in plants that used advanced technology. Again, it is important to take precautions to avoid reaching a wrong conclusion. Plants were divided into quartiles based on the average wages they reported paying their employees in 1992 because percentage gains in wages were generally greater the lower the 1992 wage levels were. For each 1992 wage quartile, the 1992-95 percentage growth in average wage was compared for low, middle, and high adopters. In each 1992 wage quartile, the fastest 1992-95 wage growth was reported by high adopters—11.3 percent for those in the lowest quartile, and 2.8 percent for those in the highest quartile (fig. 1). One reason that the other research may have found little gain in pay associated with new technology may be that it focused on larger, unionized establishments that already had high wages. Our results are not conclusive evidence that technology use leads to wage growth, but they certainly suggest that high technology leads to faster growth in pay, particularly in initially low-wage plants.

Technology-Intensive Plants Have Higher Pay and Benefits Than Others in the Same Industry

Another pitfall that we need to avoid is the possibility that the difference in earnings associated with technology is actually due to industry differences, since industries vary in their

Figure 1
Nonmetro manufacturing wage growth, 1992-95, by 1992 wage level and technology adoption

High adopters of technology reported faster wage growth



Note: Adjusted for inflation.

Source: Calculated by ERS using data from the Rural Manufacturing Survey.

use of technology. Other research has found that the rural mix of industries explains much of the overall difference in technology use between rural and urban manufacturing (see Fred Gale, *Is There a Rural-Urban Technology Gap?* AIB-736-01, USDA/ERS, August 1997).

Rural industries vary considerably in the wages and benefits they offer (table 2). The apparel industry offers the lowest wages and is least likely to offer health and retirement benefits. On the other extreme, chemical, paper, and petroleum plants tend to have the highest wages and benefits. Plants in industries that are heavily represented in rural areas (food, textiles, apparel, lumber and wood products) tend to not only be low in advanced technology use, but they also offer relatively low wages and benefits. We need to be careful, therefore, to differentiate between effects of technology and industry. It could be that differences in wages are largely due to the greater use of new technologies in more urban-oriented industries.

The RMS data indicate a considerable range in technology use within all industries, including rural-oriented industries. For example, specific types of food processing industries, such as meat packing, poultry slaughtering, fluid milk, and canned fruits, vegetables, and preserves, nearly all have both low and high adopters. Table 3 compares pay and benefits offered by low and high adopters in eight key industries for which meaningful comparisons could be made. In each industry, high adopters report higher average wages than low adopters. The difference ranges from 13 percent in fabricated metal products and industrial machinery to more than 30 percent in several industries. The percentage of plants offering both retirement and health benefits is also higher among high adopters. Again, the smallest difference (slightly more than 20 percentage points) is in fabricated metal products and industrial machinery. In the textile, apparel, and lumber and wood products industries, high-adopter plants are about twice as likely as low

Table 2

Nonmetro manufacturing wages and benefits, by industry, 1995*Manufacturing industries vary considerably in the wages and benefits they offer*

Average hourly wage (Dollars)	Share of establishments providing both health and retirement benefits		
	Under 50 percent	50 - 75 percent	Over 75 percent
Over 10		Petroleum	Chemicals
8.75 - 10.00	Nonauto transportation equipment	Industrial machinery Fabricated metal products Primary metals Printing Stone, clay, and glass Automobiles	Paper
7.50 - 8.75	Lumber	Rubber and plastics Instruments Electrical equipment Food processing Furniture Textiles Miscellaneous manufacturing	
<7.50	Apparel	Leather	

Source: Rural Manufacturing Survey.

Table 3

Nonmetro compensation by industry and technology use, 1995*High adopters provide higher wages and benefits in each of eight major manufacturing industries*

Industry	Average hourly wage of—			Plants providing health and retirement benefits		
	Low adopters	High adopters	Difference	Low adopters	High adopters	Difference
	Dollars			Percent		
Food	7.02	9.70	38.1	54.2	90.3	36.1
Textiles	7.21	8.89	23.3	45.1	91.8	46.7
Apparel	6.08	7.75	27.5	40.8	81.4	40.6
Lumber and wood products	7.39	9.63	30.3	40.5	87.6	47.1
Rubber and miscellaneous plastics	6.96	9.25	32.9	56.5	90.7	34.3
Stone, clay, and glass	8.80	10.78	22.5	66.4	98.8	32.4
Fabricated metal products	9.55	10.85	13.6	68.5	91.8	23.4
Industrial machinery	9.19	10.43	13.5	65.7	86.8	21.1

Source: Calculated by ERS using data from Rural Manufacturing Survey.

adopters to offer retirement and health benefits. (All differences between low and high adopters are statistically significant here, as elsewhere in this article.)

Technology-Intensive Plants Hire Workers with More Schooling, but Pay More No Matter What the Schooling

Advanced technology requires greater skill levels, which means workers with higher levels of schooling. In high-adopter plants, an average of 86 percent of production workers

graduated from high school compared with 78 percent in low-adopter plants. High adopters also report a higher percentage of workers with schooling beyond high school (15 versus 8 percent).

Not surprisingly, plants that hire more educated workers pay better wages. Plants where all production workers completed high school pay 27 percent more, on average, than plants where less than 75 percent of workers were high school graduates. This raises the possibility that technology wage differentials reflect differences in worker education. However, comparing plants with similar worker education levels shows once again a considerable technology advantage in wages and benefits (figs. 2, 3).

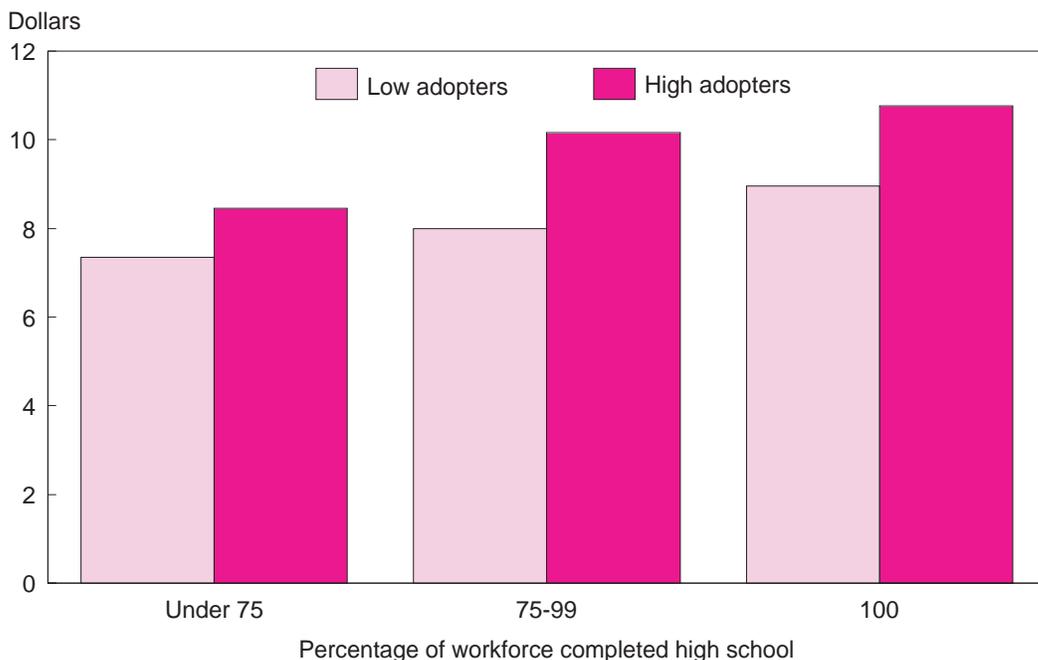
High Technology Adopters Are a Source of Higher Wages and Benefits in Counties with Low Graduation Rates

To some extent, the education level of a plant’s workers is determined by the hiring strategy of the firm, but it may also be affected by the local pool of labor available to the plant. Research has found no difference in rural-urban technology use (when comparing plants in the same industry), but technology use does vary by local education level. A manufacturing plant located in a rural county with low rates of high school graduation for prime working age adults (ages 25-44), is more likely to be a low adopter (34 percent of plants) than a plant located in a county with a high graduation rate (21 percent) (fig. 4).

Among counties with similar high school graduation rates, wages and benefits are highest in plants that are high adopters of technology. The technology advantage in wages is similar in the most and least educated counties—a difference of roughly \$2 per hour, or 25 percent (table 4).

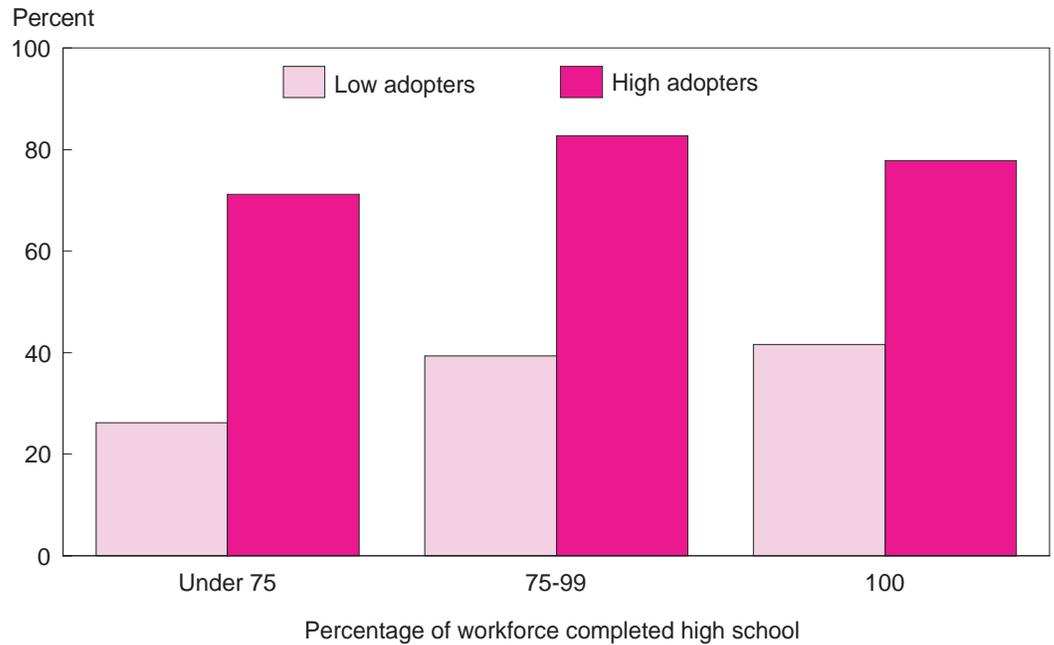
Figure 2
Nonmetro manufacturing wages, by workforce education level and technology use, 1995

High adopters pay higher wages to workers at a given education level



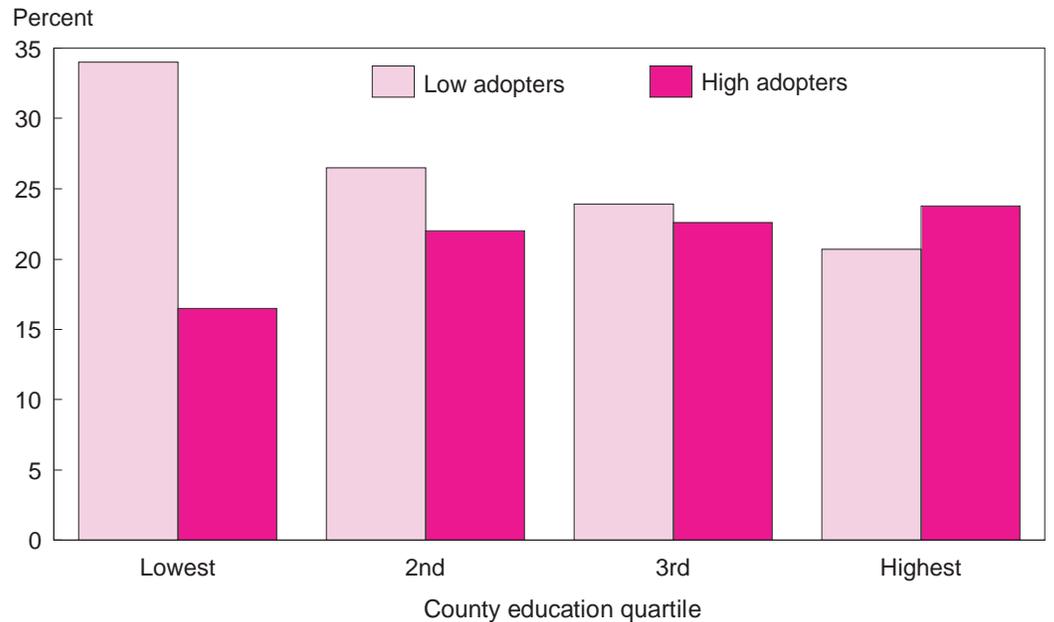
Source: Calculated by ERS using data from the Rural Manufacturing Survey.

Figure 3
Nonmetro proportion of plants offering both retirement and health benefits, by technology use and education level of workforce, 1995
High adopters are much more likely to offer benefits to workers at a given education level



Source: Calculated by ERS using data from the Rural Manufacturing Survey.

Figure 4
Nonmetro technology use, by county high school graduation level
Manufacturers in counties with low graduation rates are more likely to be low adopters of advanced technology



Note: Education quartiles are based on rates of high school completion for adults aged 25-44 in 1990.
 Source: Calculated by ERS using data from the Rural Manufacturing Survey and 1990 Census of Population.

Table 4

Nonmetro manufacturing wages and benefits, by technology use and local education levels

High technology adopters offer higher wages and benefits than low adopters in high- and low-education counties

Industry	Average hourly wage—			Plants providing health and retirement benefits		
	Low adopters	High adopters	Difference	Low adopters	High adopters	Difference
	Dollars			Percent		
Highest completion rates	8.25	10.15	23.0	45.8	75.2	29.4
Moderate—high	8.72	10.34	18.6	42.0	80.6	38.6
Moderate—low	7.84	9.93	26.7	25.1	79.1	54.0
Lowest completion rates	7.44	9.47	27.3	33.0	88.0	54.0

Note: Education quartiles are based on rates of high school completion for adults aged 25-44 in 1990.

Source: Calculated by ERS using data from Rural Manufacturing Survey.

High adopters are also likely to offer benefits. In counties with low high school graduation rates, high adopters are about more than twice as likely as low adopters to offer both retirement and health benefits.

Most High Adopters Added Jobs

Finally, we now return to the quantity side of job creation. Adopters of advanced technology appear to create “good jobs” with relatively high pay and benefits, but “good jobs” are also costly to the employer. Do advanced technology employers show a greater tendency to downsize or create relatively few jobs?

As was the case in looking at wage growth, the RMS data cannot provide conclusive evidence on this issue, since the survey was done at one point in time, and it misses plants that cut employment to less than 10 workers or that went out of business before the date of the survey in 1996. This issue was addressed by looking at reported changes in plant employment over the years 1992-95. The analysis was restricted to plants that were similar in size—those with 50-249 employees in 1992.

The data do not indicate any tendency for high adopters to downsize. In fact, nearly two-thirds of the high adopters reported job gains, a much higher proportion than among low or middle adopters (fig. 5). Low adopters were most likely to have lost jobs between 1992 and 1995. This comparison indicates that advanced technology adopters measure up well not only in job compensation, but in job “quantity” as well. The technology-job growth association does not mean that new technology adoption leads to job growth. The more competitive plants may adopt new technologies in the process of expanding their operations.

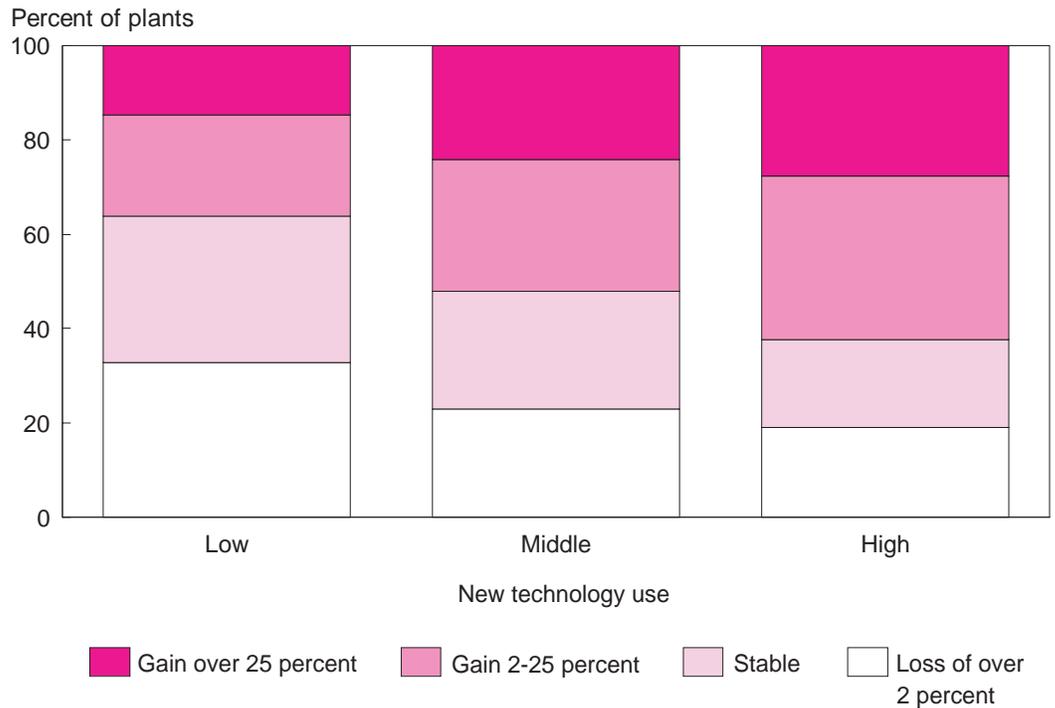
Nurturing Technology-Intensive Manufacturing Is a Promising Development Strategy

The superior pay and benefits associated with technology-intensive manufacturing seem to offer promising job prospects for workers with moderate skill levels that may offset to some degree the negative impacts of declining unionization. The greater prevalence of profit-sharing and training among technology-intensive companies gives workers a greater stake in company performance, and builds worker skills and productivity. Of course, advanced technology is not always beneficial to workers. Although most high technology-adopting plants surveyed by ERS added jobs during 1992-95, a significant share of them cut employment. Many workers object to the work environment in such plants, and have resisted new technologies and management practices that may call for faster production lines, group decisionmaking, greater responsibility for quality control, job rotation, and nontraditional methods of performance evaluation and compensation.

Policymakers and development officials at Federal, State, and local levels have recognized the advantages of new technology. Considerable effort is expended on manufacturing extension by the National Institute of Standards and Technology's Manufacturing Extension Partnership, and by State entities. Greater emphasis is now being given to rural areas. The results shown here suggest that these efforts have the potential to improve living standards by creating "good jobs" with relatively high wages and benefits. [David McGranahan, 202-694-5356, dmcg@econ.ag.gov]

Figure 5
Nonmetro manufacturing plants, by 1992-95 employment growth and technology use

Job growth was most common among high adopters of technology



Note: Plants with 50-249 employees in 1992.

Source: Calculated by ERS using data from the Rural Manufacturing Survey.

Measuring Advanced Technology Use

The 1996 Rural Manufacturing Survey (RMS, app. A, "Data Sources") asked manufacturing establishments whether they used five production technologies that are used to automate and control production processes, five new management practices that affect the way production workers do their jobs, and five telecommunications technologies. Establishments were classified as "high adopter," "medium adopter," or "low adopter," based on the number of technologies and practices they reported using. In many of the comparisons in this article, "high adopters" are compared with "low adopters" to simplify the comparisons; characteristics of "medium adopters" usually come out between the two other categories. (For more information on this topic, see Fred Gale, *Is There a Rural-Urban Technology Gap?* AIB-736-01, USDA/ERS, August 1997.)

Technologies and management practices

Production technologies	Management practices	Telecommunications
Computer-assisted design	Self-directed work teams	Modems
Computer-assisted engineering	Job rotation	Satellite communications
Numerically-controlled or computer-controlled machines	Employee problem-solving groups or quality circles	Internet Computer linkages outside the firm
Programmable controllers	Statistical process control	Computer linkages to other locations in the firm
Linked access network on factory floor	Total quality management	
Source: Rural Manufacturing Survey.		

Compensation and Training Questions

Does your establishment currently provide production workers with...

A pension or retirement plan?

Contributions toward an employees' group health insurance plan?

A profit-sharing or stock purchase plan?

Paid sick leave or vacation leave?

Do you currently pay for or provide formal training for production workers?

In 1995, what was the average hourly rate of pay received by production workers at your establishment?

Three years earlier, in 1992, what was the average hourly rate of pay received by production workers at your establishment?

Results Hold Up in More Sophisticated Statistical Analysis

The author estimated the relationships between new technology use and worker compensation when all of the factors considered in this article (plus branch plant status and proportion of women among production workers). This more sophisticated analysis showed that technology use had a smaller, but still substantial, association with earnings. In a regression of the natural log of hourly earnings on technology use and other characteristics, the wage premium paid by high users compared with low users was reduced from 25 percent to 13 percent when all factors were considered simultaneously. Much of the reduction reflected the fact that, in general, larger plants both adopt more technologies and pay higher wages.

Logistic regressions showed that the difference in the prevalence of benefits between low and high new-technology-use plants was roughly 30 percent for retirement benefits, 13 percent for health benefits, 50 percent for training, and 20 percent for profit sharing when other factors were taken into account. None of these gaps are more than a third smaller than found in simple comparisons of low and high new-technology-use plants. Most of the differences in benefits found between low and high users of new technology cannot be attributed to other plant and location characteristics.

It is conceivable that factors not measured in this study may be responsible for the greater compensation in new technology plants. But, as noted above, our other research has shown that new technology manufacturers are much more likely than old technology manufacturers to report that skill requirements have risen in the past 3 years. The greater compensation in new technology plants is consistent with their higher and rising skill requirements and their need to retain newly trained workers.